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Sub-Ice Sheet Environments in North Victoria Land during the Last Glacial Maximum

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Subglacial calcite precipitates from Boggs Valley (71°55'S; 161°31'E; elevation 1,160 m asl., Northern Victoria Land, Antarctica), provided the first radiometrically-dated petrographic, geochemical and genomic evidence of thermogenic subglacial drainage events linked to subglacial eruptions during the Last Glacial Maximum (LGM). The crusts consist of two fabrics: i) a dirty (particulate-rich) microsparite, which marks catastrophic subglacial discharges of meltwater and a ii) dark columnar calcite that formed in pockets of basal melt. Synchrotron Radiation-based micro X-Ray fluorescence reveal that the dirty microsparite is S-rich, and embeds particulates characterized by high Manganese (Mn), Yttrium (Y) and Iron (Fe) concentrations. From previous work, we also know that the microsparite layers contain organic compounds, including amino acids, from which we extracted DNA fragments of microorganisms that lived in diverse sub-Antarctic environments (Frisia et al., 2017). The elongated columnar calcites are characterized by the presence of Arsenic (As) associated with low concentrations of Mn. Both elements suggest local anaerobic, chemolitothrophic metabolism. Columnar calcite becomes increasingly rich in S near the “discharge” layers.

Our preliminary interpretation is that during the LGM subglacial volcanism was crucial to sustain life in sub-ice sheet refugia by injecting both nutrients and diverse microbes into the basal ecosystem. The otherwise nutrient-poor, anoxic subglacial environment sustained a population of chemolithotrophs, which may have also been “allochthonous”.